CHAPTER III
RESEARCH METHODOLOGY

A. Population and Sample

Populations in this research are grade 10 high school students in one of international school in Tanggerang. Number populations in this school are seven classes with 278 students. The sampling method that be used in this study is purposive sampling method. Purposive sampling method is used because researcher wants to know improvement of lower achiever students' critical thinking skill and concept comprehension. Sample of this research are 18 students in 10B class.

B. Research Method

In this research students' critical thinking skill and concept comprehension will be dependent variable while the independent variable is Problem Based learning. The method that be used in this study is quantitative method. Quantitative used to collect and analyze numerical data obtained from formal instruments. This quantitative method is using type of descriptive. Descriptive is used to describe of identified variable or phenomena (Arikunto, 2002).

C. Research design

Research design that will be used in this research is one group pre test and post test design. Where there is pretest and post test between the treatment. Thus, the results of treatment can be determined more accurately because can be compared with the situation before treated (Sugiyono, 2008:74). The research design can be illustrate as table below:

Table 3.1 One group pre test and post test design

Pre test	Treatment	Post test
O_1	X	O_2

O_1 = Pre test of students concept comprehension and critical thinking skill.

X = Problem Based Learning model

O_2 = Post test of students concept comprehension and critical thinking skill.

Steps to implement the research first time students be given pre test (O_1) to know students' prior concept comprehension and critical thinking skill then gave treatment(X) which used Problem Based Learning approach and the last gave post test (O_2) to students. Thus, it can be obtained the differences between pretest and posttest which assumed as the effect of treatment.

D. Operational Definition

To avoid misconception in this research, so there is explanation about the terms that are used in this research, as follow:

1. Problem Based Learning

   Problem Based Learning is approach that use real life problem in learning process. In this research teacher will give problem to students. Students work in group to solve problem to make students become an active learner as well as problem solver. In this research use five steps to implement Problem Based Learning such as ideas, know facts, learning issues, action plan and evaluate products and process.

2. Concept comprehension

   Concept comprehension in this research based on cognitive domain of Bloom's taxonomy new revision. The aspects that use in this research are remembering aspect (C1), understanding aspect (C2), analyzing aspect (C4) and evaluating aspect (C5).

3. Critical thinking skill

   According to Ennis critical thinking is process to make decision based on what believe and what to do. There are six aspects that include in critical thinking skills but in this research just take five aspect of critical thinking skills as indicator because the sixth aspect only asses students behavior. So to make test item for students' critical thinking researcher use five indicators such as clarification, decision, inference, advanced clarification, supposition and integration. The result of students' test will be scored by scoring guide.

E. Research Instrument

To collect the data there are some instrument that be needed:

1. Students' concept comprehension test

   To measure Students' concept comprehension test item that be used is multiple choice. Researcher made 34 multiple choice test items then would be eliminated based on analysis result of trial instrument. Total question number that be used for pre test and post test are 15 questions of multiple choice which each multiple-choice item is given a numeric value of one for correct answer and zero for incorrect. Blue print for this multiple choice is made based on cognitive aspects in Bloom's taxonomy can be seen on appendix C.1.

2. Students' critical thinking skills test

   To measure students' critical thinking test item that be used is essay. Researcher choose essay test item because more efficient to asses critical thinking. The number of question that be used are five questions which used range score from three until zero. Critical thinking skills indicator is used to make blueprint of critical thinking skills test as shown on appendix C.3.

3. Observation sheet

   There are two kinds of observation sheets that will be used in this research such as:

   a. Teacher's observation sheet

      This observation sheet is advantageous to investigate whether process of Problem Based Learning run well or not. This observation sheet can be seen on appendix C.5

   b. Students' observation sheet

      This observation sheet is advantageous to investigate students' activities during learning process is appropriate or not with problem Based Learning. This observation sheet can be seen on appendix C.6

4. Questionnaire of students' response

   This questionnaire is used to know students' response toward Problem based Learning process. Students must fulfil the questionnaire by give mark on scale number which presents their agreement for option "YES" and disagreement for option "NO". The interview guideline used to know teacher point of view as additional information about learning process through Problem Based Learning and students' critical thinking skill.

5. Teacher interview

The interview carried with biology teachers who teach in class that were used as research subjects. This interview is intended to find out teachers' opinions toward Problem Based learning.

F. Validation of Instruments

To validate the instrument in this research, there are some steps were done as follow:

1. Instruments judgment

After made the instrument, the instruments were reviewed and judged by the experts. The experts are lecturer of biology and pedagogy who expert in assessment. Based on judgment researcher got some suggestions and revision for instrument.

2. Instruments trial

Before the instruments are used for research implementation, the instruments were tested to students that already learn about pollution. In this case researcher chose grade XI as trial instruments participants.

3. Instruments Analysis

The instruments that are used in this research were judge and trial to other students. The result from instrument trial analyzed to get its validity, Reliability, difficulty level and discriminating power.

a. Validity

Based on Scarvia B. Anderson and friends “a test is valid if it measures what it purpose to measure” (in Arikunto, 2012:80). “Validity refers to the appropriateness, meaningfulness, correctness, and usefulness of the inferences a

researcher makes" (Fraenkel *et al.*, 2012:147). To measure the validity of instruments researcher used software. Software calculation actually uses product moment correlation formula as follow (Arikunto, 2012:87):

$$r_{XY} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)^2\}}}$$

r_{xy} : correlation coefficient between test item and total score.

N : number of participant

X : score of the test item

Y : total score

Value of r_{xy} which was obtained can be interpreted to determine validity of test item by using criteria on table 3.2

Table 3.2 Interpretation of validity of test item

Value of r_{xy}	Category
0,80-1,00	Very high
0,60-0,79	High
0,40-0,59	Sufficient
0,20-0,39	Low
0,00-0,19	Very low

(Arikunto, 2012)

b. Reliability

Reliability is the provision of a test when retested to the same subject. To know this provision essentially can be seen from alignment of the result (Arikunto, 2012:104). To measure test item reliability researcher used software which based on formula above (Arikunto, 2012:115):

$$r_{xx} = \frac{K}{K-1}\left(\frac{s_x^2 - \Sigma pq}{s_x^2}\right)$$

r_{xx} = reliability of the whole test

K = number of items on the test

S_x^2= variance of scores on the total test (squared standard deviation)

p = proportion of correct responses on a single item

q = proportion of incorrect responses on the same item

Table 3.3 Interpretation of reliability

Value of r_{xy}	Category
0,80-1,00	Very high
0,60-0,79	High
0,40-0,59	Sufficient
0,20-0,39	Low
0,00-0,19	Very low

(Arikunto, 2012)

c. Difficulty level

Difficulty level is to measure whether the test item is difficult or not. This is important to measure the difficulty level of test item because a good test item is not too easy and not too difficult for students (Arikunto, 2012:222). So according to Arikunto (2012) difficulty index scale can show difficulty level of test item. To know the difficulty level of test item can use the formula below:

$$P = \frac{B}{JS}$$

P = difficulty level

B = amount of student who answer question with the right answer

JS = total amount of students who undertakes the test

d. Discriminating power

Discriminating power is ability to distinguish between lower and higher achiever from the result of test item (Arikunto, 2012:226). The formula that can be used as follows:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$

D = discriminating power

JA = amount of high achiever

JB = amount of low achiever

BA= amount of high achiever who answers question with the right answer

BB= amount of low achiever who answers question with the right answer

P_A = proportion of high achiever who answers question with the right answer

P_B = proportion of low achiever who answers question with the right answer

Table 3.4 Interpretation of discriminating power

Discriminating power interval	Category
Negative	Test item is not appropriate
$0.00 < x \leq 0.20$	Poor
$0.21 < x \leq 0.40$	Sufficient
$0.41 < x \leq 0.70$	Good
$0.71 < x \leq 1.00$	Excellent

(Arikunto, 2012)

G. Collecting Data Technique

To collect data some steps done the steps are including gave pre test first before implementation of Problem Based Learning then analyze the result of pretest, gave treatment by using Problem Based Learning during that process data were taken based on observation sheet, gave post test then analyze the result of posttest, gave questionnaire to students and the last had interview with Biology teacher.

H. Data Analysis Techniques

1. Scoring

Gave score to students' concept comprehension and critical thinking skill test. For concept comprehension test gave score 1 for right answer and 0 for false answer while for critical thinking skill test used scoring guide. The formula used to convert score into percentage as follow:

$$\text{Student's score (\%)} = \frac{\text{total right answer}}{\text{Maximum score}} \times 100\%$$

After percentage of students' score were obtained, it can be classified based on score percentage category according to Arikunto as follow:

Table 3.5 Category of student score

Percentage (%)	Category
76-100	Good
56-75	Sufficient
40-55	Poor
0-39	Very poor

(Source: Arikunto, 2012)

2. Gain and Normalized Gain

To find out the difference between pretest and posttest score can use gain formula. The formula which is used to calculate the gain value is:

$$G = S_f - S_i$$

(Hake, 1998)

With:

G = gain

S_f = post test score

S_i = pretest score

To see the improvement of students' concept comprehension and critical thinking skill used normalized gain as it shown as formula below:

$$< g >= \frac{(\%S_f - \%S_i)}{(100 - \%S_i)}$$

(Hake, 1999)

With:

$<g>$ = normalized gain

S_f = posttest score

S_i = pretest score

Normalized gain value which is obtained will be interpreted into gain index category according to Hake in table 3.7:

Table 3.6 N-gain index category

N-Gain	Category
g > 0,7	High
0,3 < g < 0,7	Medium
g < 0,3	Low

(Hake, 1999)

3. Analysis of Problem Based Learning implementation

To measure the successful of implementation learning process used the formula below:

$$\text{Percentage of implementation} = \frac{\Sigma \text{ observer answer}}{\Sigma \text{ amount observer}} \times 100\%$$

After percentage of implementation was obtained, researcher interpreted the data into category in table 3.8 below:

Table 3.7 Percentage of learning implementation category

Percentage	Category
80% or more	Very good
60%-79%	Good
40%-59%	Sufficient
21%-39%	Low
0%-20%	Very low

(Ridwan, 2000)

4. Students response analysis

To analyzed students response in learning process through Problem based Learning used formula as following:

$$\text{Percentage of students' response} = \frac{\Sigma \text{ students who answer 'yes'}}{\Sigma \text{ amount students}} \times 100\%$$

5. Interview analysis

Analyze interview result of teacher's opinion toward Problem Based Learning

I. The Result of Trial Test Instrument

The instruments were tested before it is used in this research. It is tested to grade XI of senior high school at one international school in Tanggerang who already learned the same topic. There are two kinds of test that are used those are multiple choice containing 34 items and essay containing 18 items.

From trial instrument result, researcher analyzed the result to get validity, reliability, difficulty level and discriminating power. For concept comprehension test item were analyzed by using *ANATES pilihan ganda* Version 4.1.0, meanwhile critical thinking test were analyzed by using *ANATES uraian* Version 4.0.7. The recap result of validity, discriminating power and difficulty level of concept comprehension can be seen on table below.

Table 3.8 Recapitulation of validity concept comprehension test

Category	Question number
High	5,7,11,17,22,24,26,32,33,34
Sufficient	13,20,29
Low	1,3,8,9,14,16,19,21,28

Continue Table 3.8 Recapitulation of validity concept comprehension test

Category	Question number
Very Low	4,10,12,15
Invalid	2,6,18,23,25,27,30,31

Table 3.9 Recapitulation of discriminating power concept comprehension test

Category	Question number
Excellent	7,11,17,26,33,34
Good	5,13,1421,22,24,29,32
Sufficient	3,4,8,12,16,19,20,28
Poor	1,29,1015
Not Appropriate	6,18,23,25,27,30,31

Table 3.10 Recapitulation of difficulty level concept comprehension test

Category	Question number
Very Difficult	6,18,25,27,30,31
Difficult	12,23
Fair F	7,10,11,15,17,19,26
Easy	4,5,8,9,13,14,16,20,21,22,24,32,33,34
Very Easy	1,2,3,29

Recapitulation of validity, discriminating power and difficulty level of critical thinking skills illustrated in the following table below.

Table 3.11 Recapitulation of validity critical thinking skills test

Category	Question number
High	2a,2b,6a,6b

Continue Table 3.11 Recapitulation of validity critical thinking skills test

Category	Question number
Sufficient	2d,3,4a,5b,7b,7c
Low	2c,4b,7a
Very Low	1a,1b,1c,5a
Invalid	-

Table 3.12 Recapitulation of discriminating power critical thinking skills test

Category	Question number
Excellent	6c
Good	2a,2b,2d,36a,6b
Sufficient	2c,4a,4b,5b,7c
Poor	1a,1b,1c,5a,7a,7b
Not Appropriate	-

Table 3.13 Recapitulation of difficulty level critical thinking skills test

Category	Question number
Very Difficult	-
Difficult	2a,7c
Fair	1c,2b,2c,2d,3,4a,5a,5b,6a,6b,6c,7a
Easy	1a,7b
Very Easy	1b,4b

Based on Concept comprehension trial test were obtained that reliability value of instruments is as much as 0.81 which include as very high category. Meanwhile in critical thinking skills test reliability value is 0.75 which include as high category. Thus, it showed that those test are qualified to be used.

J. Research Procedure

There are many steps that are done during this research which classified into three stages of research procedure. Three stages are preparation stage, implementation stage and final stage which are explained in detail below:

1. Preparation stage

   In preparation stage first researcher did some literature review from both digital media and printed media. after got an idea about research topic researcher made research proposal which already presented in proposal seminar then researcher done some revision which given by judges. Based on consultation with supervisor and teacher in the school, researcher made research instrument and designed lesson plan for implementation Problem Based Learning. Instruments and lesson plan that made were judged by expert in this research expert were lecturer and teacher. Researcher also revised instruments based on judgment after revision the instruments tried to upper grade students then analyzed the result to find validity, reliability, discriminating power and difficulty level test item that qualified for students.

2. Implementation stage

   In implementation stage first gave pretest to students before implementation of Problem Based Learning then implemented Problem Based Learning in pollution concept. After implementation students were given posttest and questionnaire. The last interviewed biology teacher to know teacher's response about Problem Based Learning model.

3. Final stage

   In final stage, researcher made discussion based on data interpretation and took conclusion based on research result and discussion.

K. Research Scheme

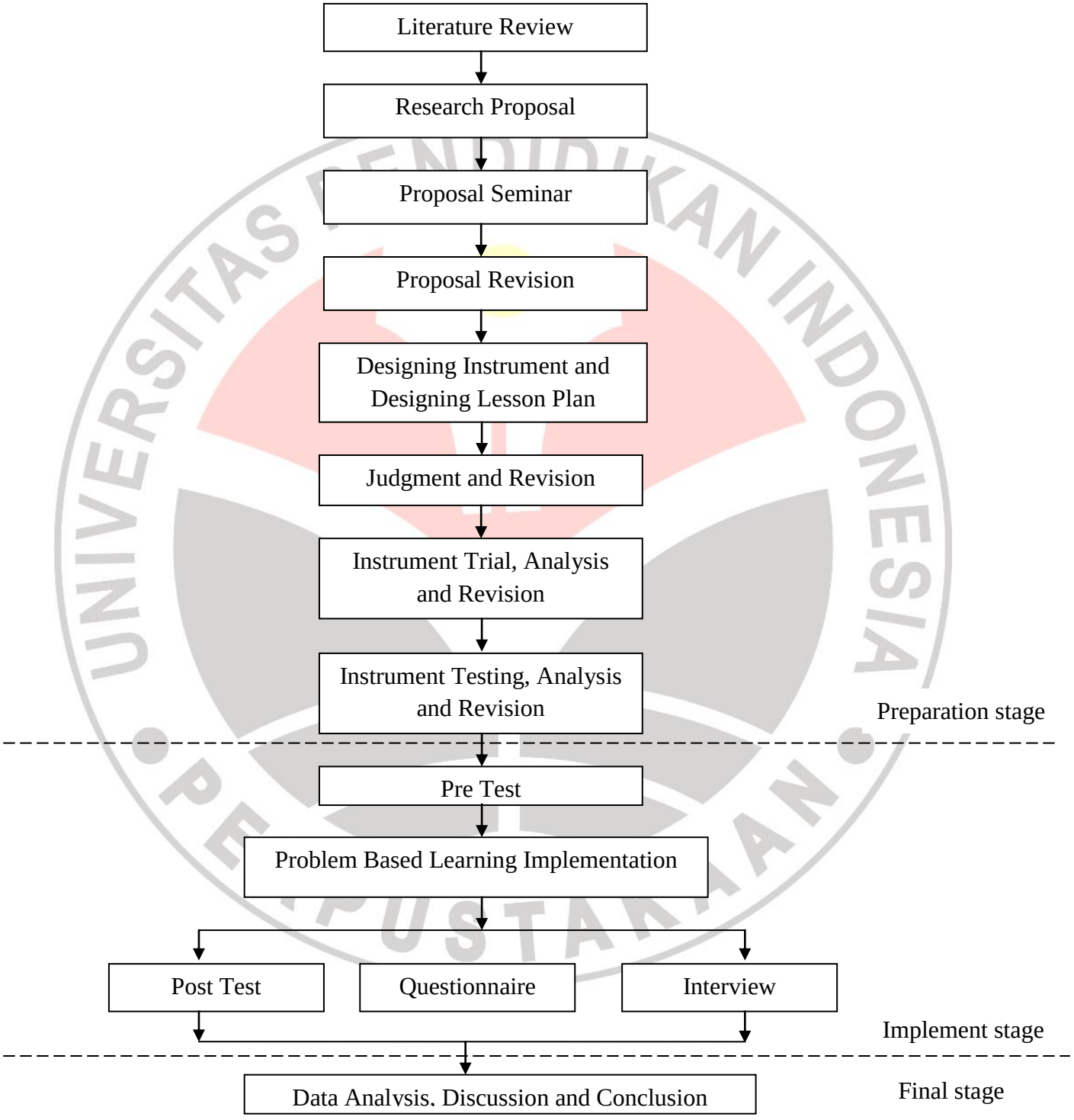

Figure 3.1 Research Scheme